Reuse Working Group

Outgoing Chair: Robert Wolfe (NASA GSFC)
Co-Chair: Al Fleig (PITA Analytic Sciences)
Presenter: James Marshall (Innovim)

8th Earth Science Data Systems Working Group Meeting
Wilmington, Delaware
October 20–22, 2009

- Working Group Members

- Background

- Activities and Accomplishments
  - Summary of Activities
  - Recommendations to Headquarters
  - Reuse Portal Web Site
  - Reuse Enablement System (RES)
  - Reuse Readiness Levels (RRLs)
  - Software Reuse Peer-Recognition Award

- Breakout Session Agenda

Members 2009 / Mailing List

- Nadine Alameh (MobiLaps / NASA GSFC)
- Stephen Berrick (NASA GSFC)
- Angelo Bertolli (Innovim / NASA GSFC)
- Corey Bettenhausen (SSAI / NASA GSFC)
- Bruce Caron (New Media Studio)
- Bradford Castalia (University of Arizona)
- Saurabh Channan (University of Maryland)
- Victor Delnore (NASA LaRC)
- Robert Downs (CIESIN, Columbia U.)
- Yonsook Enloe (SGT Inc. / NASA GSFC)
- Stephan Falke (Washington University in St. Louis)
- Al Fleig (PITA / NASA GSFC)
- Mike Folk (NCSA)
- Bill Frakes (Virginia Tech.)
- Ryan Gerard (Innovim / NASA GSFC)
- Larry Gilliam (Innovim / NASA GSFC)
- Emily Greene (Raytheon / NASA JPL)
- Mary Hunter (Innovim / NASA GSFC)
- Gary Jackson (University of Maryland)
- Tommy Jasmin (University of Wisconsin, Space Science Engineering Center)

- Virginia Kalb (NASA GSFC)
- Louis Kouvaris (NASA GSFC)
- Kwo-Sen Kuo (NASA GSFC)
- Michael Leyton (Rutgers University)
- James Marshall (Innovim / NASA GSFC)
- Chris Mattmann (NASA JPL)
- David McComas (NASA GSFC)
- Neal Most (NASA GSFC)
- Steve Olding (Everware–CBDI / NASA GSFC)
- Margaret Pippin (NASA LaRC)
- Shahin Samadi (Innovim / NASA GSFC)
- Mark Sherman (SGT Inc. / NASA GSFC)
- Ross Swick (NSIDC – Boulder)
- Bill Teng (SSAI / NASA GSFC)
- Curt Tilmes (NASA GSFC)
- Bruce Vollmer (NASA GSFC)
- Petr Votava (NASA Ames)
- Frederick Watson (California State University, Monterey Bay)
- Christine Whalen (NASA GSFC)
- Jonathan Wilmot (NASA GSFC)
- Bruce Wilson (ORNL)
- Robert Wolfe (NASA GSFC)

42 Members on the Mailing List

3

Background

- About the NASA Earth Science Data Systems (ESDS) Software Reuse Working Group (WG):
  - The WG was started in 2004 to facilitate reuse of software assets within the NASA Earth science community.
  - Membership is limited to NASA-funded projects and investigators, though there have been many contributions from the general Earth science community.
  - The WG has been working to establish a "marketplace" for reusable Earth science software artifacts by working to increase the supply and availability of reusable assets.
  - Also, the WG has worked to increase the community capacity and desire for reuse by demonstrating the feasibility and value of reuse.
  - Through regular meetings of the full WG and a smaller support team, a variety of activities are performed to encourage and enable reuse.
- Goals of the Reuse WG include:
  - To spend less time, money, and effort on software development
  - To increase productivity and improve quality through reuse
  - To increase the number of available reusable assets

Reuse WG Charter Highlights

- Purpose
  - Address technical issues required to enable and facilitate reuse of software assets, including open source products, within the NASA Earth science community

- Goals
  - Demonstrate the feasibility and value of reuse
  - Increase the supply and availability of reusable assets
  - Make recognizable and easy-to-evaluate candidate reuse solutions
  - Minimize the cost of infrastructure activities to support the community's reuse activities
  - Increase community capacity and interest in reusing existing assets
  - Contribute to the removal of existing barriers to reuse
  - Recommend incentives to encourage reuse

- Scope
  - Facilitating reuse across projects and not interfering with local control of participating systems
  - Focusing on reuse process and not on technology infusion process
  - Focusing on reuse of existing assets rather than reusability of newly developed assets
  - Focusing not only on software code, but also on design artifacts (architectures, software designs, ICDs, test plans, etc.)
  - Focusing on reuse of proven operational and NASA Earth science specific software assets
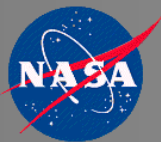
Reuse WG Activities

Reuse Implementation Projects
Efforts that result in the publication or use of a reusable component

Support/Enablement Activities
Efforts that provide tools and mechanisms to enable reuse

Outreach and Education Activities
Efforts that increase community awareness and understanding of benefits, best practices, etc.

Policy Change Activities
Efforts to reduce policy barriers to reuse

Reuse Incentive Activities
Awards and structural changes that directly or indirectly encourage reuse

- Examples of work in some of these areas include:
  - Recommending that NASA create a Reuse Enablement System (repository) for Earth science reusable software assets; development of Reuse Readiness Levels
  - Creating a web site to promote and provide information about reuse
  - Providing NASA with policy recommendations to encourage reuse
  - Developing a reuse peer-recognition award
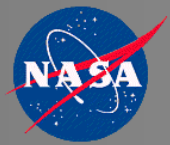
Summary of Activities

2009 Major Accomplishments

- Software Reuse Enablement System (RES)
  - Made minor revisions and updates to prototype RES
  - Completed initial document on RES operation/maintenance policies
  - Completed initial RES Test Plan document
- Software Reuse Portal Web Site
  - Continued to maintain and update site
  - Continued to publicize site to the community
- Guidelines and Best Practices
  - Began examining guidelines for packaging and distributing assets
  - Discussed other topics for future work and guidelines
- Continued development of Reuse Readiness Levels (RRLs)
- Continued software reuse peer-recognition award
- Contributed to knowledge on reuse with publications and presentations
- Continued weekly support team telecons and monthly WG telecons
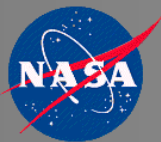
- *Reuse Enablement System*
  - Continued developing and testing prototype system
  - Vetted RES Policies internally
  - Completed initial RES Test Plan (still under review)

- *Reuse portal*
  - Provided more content and kept up to date
  - Promoted portal to community

- *Incentives*
  - Continued running peer-recognition award

- *Metrics/measurement*
  - Generated/analyzed statistics for portal web site activity

- *Promote reuse*
  - Continued publishing and presenting on reuse
  - Special sessions at ESIP Winter Meeting and AGU Fall Meetings
  - Continued developing Reuse Readiness Levels (RRLs)

- *Policy*
  - Continued communications with IPP Office to improve guidelines on release process
  - Considered how to work with decadal survey missions and in data life cycle area

Publications and Presentations

- 7th ESDS WG Meeting
  - 1 poster
  - 2 invited talks
- Abstracts and poster presentations
  - 2008 Fall AGU Meeting
  - 2009 Fall AGU Meeting (upcoming)
- Papers and oral presentations
  - 2009 ESIP Federation Winter Meeting
  - 2009 Earth and Space Science Informatics Workshop
    - Paper submitted to Earth Science Informatics journal (Springer)
  - Paper on RRL uses planned for submission to journal (TBD)
- Invited book chapter
  - In *Aerospace Technologies Advancements* by IN-TECH
- Special sessions
  - Winter ESIP Meeting (2009)
 - Fall AGU Meeting (2008 held, 2009 scheduled)

Recommendations to Headquarters

- Enabling Systems Recommendations (January 2004)
  - NASA should establish a web-based system to facilitate cataloging and a web-based repository system for distributing reusable assets for the Earth science community.
    - Policies, Test Plan, and related documentation being prepared
  - NASA should establish a web-based information portal for the sharing and dissemination of information about software reuse practices for the Earth science community.
    - Software Reuse portal web site has been established
    - Portal web site is actively updated and maintained
- Reuse Incentives (Spring 2008)
  - NASA should recognize and officially support a Peer-Recognition Software Reuse Award operated by the Reuse WG.
    - WG has created an award at its level
    - WG is examining the possibility of a higher-level award

Software Reuse Portal Web Site
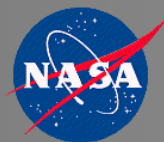
- Home/News ☑☑☑
  - Latest news and information
  - Upcoming events
  - Links to important/new items
- Reusable Assets ☑☑☑
  - Links to various catalogs (e.g., GCMD, GSFC open source site)
- Open Source ☑☑☐
- Funding Opportunities ☑☐☐
  - Information about funding opportunities for reuse
- Resources ☑☑☐
  - Specific resources are shown in the screenshot.

Basic Web Stats (12/01/2005 to 10/18/2009):
- Over 42,000 visits and 110,000 page views
- Over 32,000 unique visitors
- Average about 900 visitors/month

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you are here: home → resources

news

Fall AGU Abstracts Due Sept. 3
2009-08-03

Reuse Session at 2009 AGU Fall Meeting
2009-07-23

8th ESDS WG Meeting Announced
2009-07-17

2008 Peer-Recognition Award Recipients
2008-10-17

More news...

upcoming events

AIAA Space 2009
Pasadena, California,
2009-09-14

11th International Conference on Software Reuse (ICSR11)
Falls Church, Virginia,
2009-09-27

Geological Society of America 2009 Annual Meeting
Portland, Oregon,
2009-10-18

Free and Open Source Software for Geoinformatics 2009 (FOSS4G)
Sydney, Australia,
2009-10-20

8th ESDS WG Meeting
Wilmington, Delaware,
2009-10-20

Previous events...
Upcoming events...

Resources

▲ Up one level

Suggest Content — last modified 2007-05-04 02:41 PM
Is there other content that you think should be listed here?

Awards — last modified 2009-04-16 12:31 PM
Awards that may be relevant to reuse projects. Includes information about the WG's Peer-Recognition Software Reuse Award and past recipients of this award.

Books and Articles — last modified 2009-04-16 12:33 PM
Some suggested background reading. Books that are listed have been found relevant by one or more members of the working group. Articles that are listed have gone through a review process within the working group to assess their relevance to our site and audience. At least three people review each article, provide their reviews to an editor, and when a consensus is reached, the editor accepts/rejects the article for inclusion on the web site. Accepted articles are added to the site. Suggested items that have not gone through the above review process are listed in a separate "Additional Reading" subfolder.

Events — last modified 2007-05-25 01:28 PM
Upcoming conferences, conventions, and meetings

Featured Projects and Technologies — last modified 2007-05-09 08:12 AM
Highlights of projects that employ software reuse and information about reuse in new and emerging technologies

Groups — last modified 2007-05-09 08:10 AM
Other groups involved with software reuse.

Guideline Documents — last modified 2007-09-20 11:22 AM
A set of guidelines on various topics in the area of bottom-up reuse, most based on presentations from the 5th ESDS WG Meeting, and other areas relevant to software reuse.

Initiatives — last modified 2005-07-29 01:47 PM
Programs, standards, and other initiatives that support software reuse.

Library — last modified 2009-05-29 07:44 AM
Downloadable working group publications, presentations, case studies, and other documents

Reuse Enablement System (RES) — last modified 2009-04-27 06:42 AM
Documents related to the WG's proposed Reuse Enablement System (RES) for encouraging and enabling reuse in Earth science. Larger versions of images displayed in this folder can be obtained by clicking on the thumbnail images.

Reuse Readiness Levels (RRLs) — last modified 2009-06-18 08:08 AM
Information about the Reuse Readiness Levels (RRLs) the WG has developed for measuring the maturity of technologies in a reuse sense and their readiness to be reused.
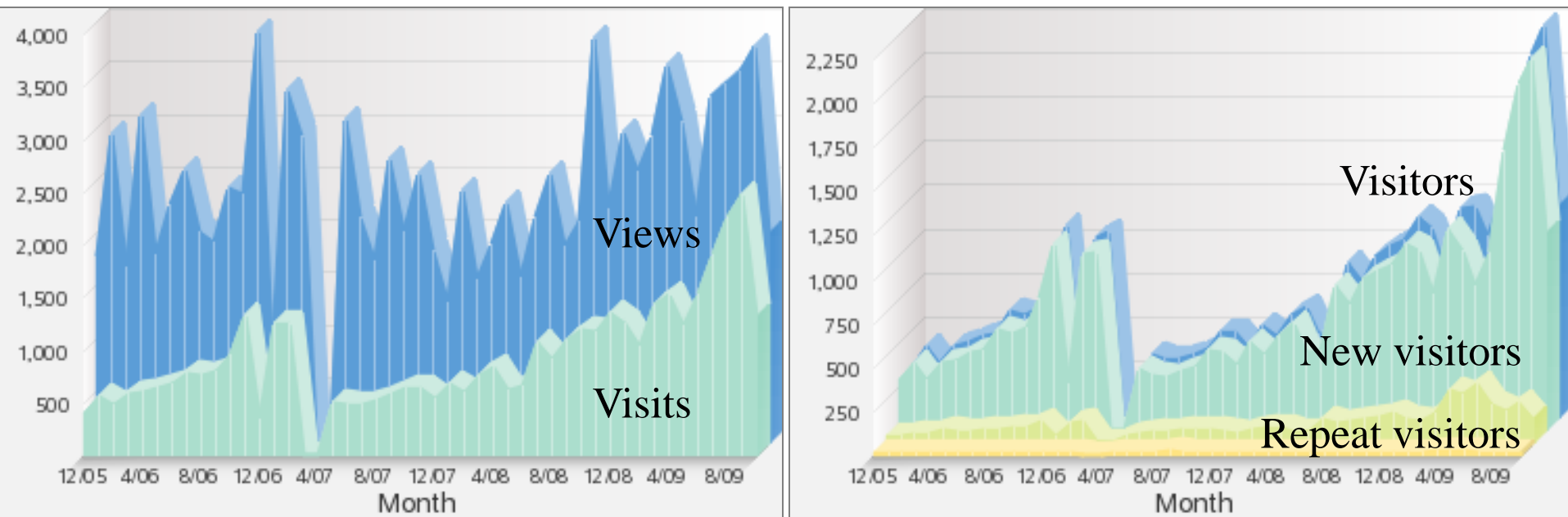
Technology Readiness Levels — last modified 2006-05-09 10:14 AM
Links to information about Technology Readiness Levels (TRLs) and similar, alternative measures of technology maturity.

Tools — last modified 2005-05-27 02:11 PM
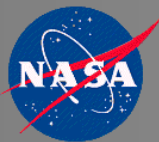Commonly used tools for enabling software reuse

These two plots show the general growth
of the site over almost 4 years.

Note: y-axes have different scales

Reuse Enablement System (RES)

- **Enabling Systems Recommendation**
  - **NASA should establish a system to facilitate the cataloging and distribution of reusable assets for the Earth science community.**
- *NASA Headquarters tasked the Working Group to look at the roles of the GCMD, Open Source Agreement site, and other sites* in serving the community and meeting reuse needs.
- Requirements and use cases for the proposed system were identified and documented.
- A trade study was conducted and concluded that none of the existing operational sites fulfilled the role of a software repository of reusable assets for the Earth science community.
- An architecture study was conducted by the Working Group to determine the most suitable way to create the recommended reuse catalog/repository.
- The WG also has developed a test plan and a draft set of policies for the operation and maintenance of the proposed RES.
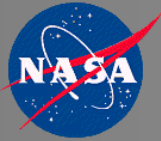
RES Prototype Development

- Implementation of a prototype RES (initially for NASA-only use)
  - Prototype would demonstrate the usefulness of the RES and its effectiveness at meeting the reuse needs of the community of Earth science software developers.
  - A prototype of the proposed system has been completed.
  - Some additional features, such as linking of multiple versions of a single asset, have been added, and minor updates continue as needed.
  - Formal testing of the prototype is pending the finalization of a Test Plan document, currently being reviewed by the WG.
- Deployment of the RES
  - The WG plans to work with NASA to determine an appropriate home for the proposed RES (e.g., ESDIS, data centers, NASA Program Office)
  - Initially, the system would be deployed for NASA-only use and testing in this environment.
  - Following successful NASA-only use, permission for deployment to the wider scientific software development community would be sought.

Reuse Readiness Levels (RRLs)

- Having a measure of the reusability of an asset:
  - Provides potential reusers with additional information about the reuse maturity of the asset:
    - Lets them know what they're getting
    - Gives them a basic feel for what modifications may be needed
  - Helps potential reusers make better informed choices about:
    - What to reuse
    - What best meets their needs
- This measure can be used as a piece of metadata for assets placed in the proposed RES (or anywhere else).
- In an iterative process, volunteers from the WG:
  - Wrote an initial set of levels for each topic,
  - Drafted summaries of each RRL, looking across all topic areas at each level,
  - Created a set of summary RRLs with descriptions by combining information from all topics at the same level, and
  - Made suggested revisions to RRLs and topic area levels based on feedback received from the community.
- The WG is reviewing and revising use cases that have been developed.
- The WG plans to use the RRLs to assess some reusable assets and use the results to revise the levels as needed to ensure consistent assessments can be made.
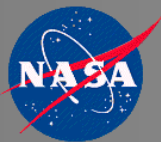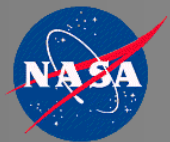
RRL Topic Areas and Levels

- Topic areas included:
    - Documentation
    - Extensibility
    - Licensing
    - Modularity
    - Packaging
    - Portability
    - Standards compliance
    - Support
    - Verification/Testing
- A scale of 1–9 was used to match the Technology Readiness Level (TRL) scale.
- Topic levels were combined into a single RRL scale.
- A sample RRL calculator was also developed (currently only on the prototype RES) as a means to help providers and consumers rate the reusability of software assets by calculating weighted averages of topic area levels.

Example from Testing/Verification

RRL 4 – Software application tested and validated in laboratory environment

Following successful testing of inputs and outputs, the testing would include integrating an application to establish that the "pieces" will work together to achieve concept-enabling levels. This validation must be devised to support the concept that was formulated earlier and should also be consistent with the requirements of potential system applications. The validation is relatively "low-fidelity" compared to the eventual system: it could be composed of ad hoc discrete components in a laboratory; for example, an application tested with simulated inputs.

22

| Level	Summary	Description
RRL 1	**Limited reusability**; the software is not recommended for reuse.	Little is provided beyond limited source code or pre-compiled, executable binaries. There is no support, contact information for developers or rights for reuse specified, the software is not extensible, and there is inadequate or no documentation.
RRL 2	**Initial reusability**; software reuse is not practical.	Some source code, documentation, and contact information are provided, but these are still very limited. Initial testing has been done, but reuse rights are still unclear. Reuse would be challenging and cost-prohibitive.
RRL 3	**Basic reusability**; the software might be reusable by skilled users at substantial effort, cost, and risk.	Software has some modularity and standards compliance, some support is provided by developers, and detailed installation instructions are available, but rights are unspecified. An expert may be able to reuse the software, but general users would not.
RRL 4	**Reuse is possible**; the software might be reused by most users with some effort, cost, and risk.	Software and documentation are complete and understandable. Software has been demonstrated in a lab on one or more specific platforms, infrequent patches are available, and intellectual property issues would need to be negotiated. Reuse is possible, but may be difficult.
RRL 5	**Reuse is practical**; the software could be reused by most users with reasonable cost and risk.	Software is moderately portable, modular, extendable, and configurable, has low-fidelity standards compliance, a user manual, and has been tested in a lab. A user community exists, but may be a small community of experts. Developers may be contacted to request limited rights for reuse.
RRL 6	**Software is reusable**; the software can be reused by most users although there may be some cost and risk.	Software has been designed for extensibility, modularity, and portability, but software and documentation may still have limited applicability. Tutorials are available, and the software has been demonstrated in a relevant context. Developers may be contacted to obtain formal statements on restricted rights or to negotiate additional rights.
RRL 7	**Software is highly reusable**; the software can be reused by most users with minimum cost and risk.	Software is highly portable and modular, has high-fidelity standards compliance, provides auto-build installation, and has been tested in a relevant context. Support is developer-organized, and an interface guide is available. Software and documentation are applicable for most systems. Brief statements are available describing limited rights for reuse and developers may be contacted to negotiate additional rights.
RRL 8	**Demonstrated local reusability**; the software has been reused by multiple users.	Software has been shown to be extensible, and has been qualified through test and demonstration. An extension guide and organization-provided support are available. Brief statements are available describing unrestricted rights for reuse and developers may be contacted to obtain formal rights statements.
RRL 9	**Demonstrated extensive reusability**; the software is being reused by many classes of users over a wide range of systems.	Software is fully portable and modular, with all appropriate documentation and standards compliance, encapsulated packaging, a GUI installer, and a large support community that provides patches. Software has been tested and validated through successful use of application output. Multiple statements describing unrestricted rights for reuse and the recommended citation are embedded into the product..

Software Reuse Peer-Recognition Award

- Designed by the WG to recognize the contributions and achievements of those people and projects whose efforts in the area of software reuse further the work of NASA Earth science research.

- Awards are decided annually in early September.

- Number of awards given is based on the quality of the nominations received.

- Awards may be issued in any or all of three categories:
  - Contribution
  - Utilization
  - Peer Education

- Details about the award can be found in the process document on the portal web site.

Awards for 2009 will be presented on Thursday morning.

Reuse Breakout Sessions
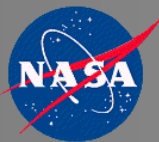
Reuse Breakout Agenda

- ## Day 1, Breakout #1 (2 pm)
  - Introductions and opening business
  - *Invited speaker: Dale Clarke (NASA GSFC, IPP Office)*
    - NASA software release process
  - Discussion of packaging and distributing reusable assets
- ## Day 2, Breakout #2 (11 am)
  - Discussion of decadal survey missions and the WG
- ## Day 2, Breakout #3 (1:30 pm)
  - *Invited speaker: John Schnase (NASA GSFC)*
    - Invasive Species Forecasting System as a case study in packaging and distributing a highly tailorable Earth science application
  - Discussion of packaging and distributing reusable assets
- ## Day 2, Breakout #4 (4 pm)
  - Discussion of Reuse Readiness Levels (RRLs)
  - WG leadership discussion and co-chair election
  - Planning for next year
- ## Day 2, Poster (5:30 pm): service-oriented software reuse

Backup Slides